First Human Isolate of Salmonella enterica Serotype Enteritidis Harboring bla_{CTX-M-14} in South America

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We studied a clinical isolate of Salmonella enterica serotype Enteritidis showing resistance to oxyiminocephalosporins. PCR analysis confirmed the presence of bla_{CTX-M-14} linked to IS903 in a 95-kb IncI1 conjugative plasmid. Such a plasmid is maintained on account of the presence of a pdnAC addiction system. Multilocus sequence typing (MLST) analysis indicated that the strain belongs to ST11. This is the first report of bla_{CTX-M-14} in Salmonella Enteritidis of human origin in South America.

During the first decade of the 21st Century, there has been a rapid worldwide dissemination of CTX-M-derived extended-spectrum β-lactamases (ESBLs) (6). Nevertheless, this process had begun as early as the 1990s in both Latin America and Europe (23). In South America, enteropathogens such as Vibrio cholerae and Salmonella spp. were among the first microorganisms found to be carrying bla_{CTX-M-2} (24, 25). After a period of CTX-M-2 prevalence in the region (22, 28), new CTX-M variants started to be progressively reported worldwide (1, 13, 21).

Salmonella enterica serotype Enteritidis (Salmonella Enteritidis) together with Salmonella enterica serotype Typhimurium are the main serovars associated with human salmonellosis throughout the globe, causing digestive tract infections and invasive infections linked to food-borne diseases (15). Although antibiotic treatment of gastroenterocolitis (due to microorganisms other than Shigella spp.) is limited to life-threatening infections in children, elderly people, or immunocompromised patients, enteropathogenic microorganisms have already been pointed out as a reservoir of antibiotic resistance genes (25, 30). In Uruguay, Salmonella Enteritidis and Salmonella Typhimurium are the most frequent agents of food-borne diseases (3, 4, 18), and historically they have remained susceptible to oxyiminocephalosporins (3, 18).

In January 2011, a 67-year-old patient with chronic renal failure but not requiring dialysis was admitted to the Hospital Pasteur of Montevideo, Uruguay, due to a gastroenterocolitis syndrome that aggravated his renal failure. Stool samples yielded Salmonella enterica serotype Enteritidis (strain SE1101). Serotyping was confirmed at the Centro Nacional de Biotecnológico, Instituto de Higiene, Facultad de Medicina, Universidad de la República, Montevideo, Uruguay, due to a gastroenterocolitis syndrome (15). According to García-Fulgueiras et al. (13), IS903 in a 95-kb IncI1 conjugative plasmid. Such a plasmid is maintained on account of the presence of a pdnAC addiction system. Multilocus sequence typing (MLST) analysis indicated that the strain belongs to ST11. This is the first report of bla_{CTX-M-14} in Salmonella Enteritidis of human origin in South America.

The probable association of bla_{CTX-M-14} with insertion sequences IS{Ecp1}, IS26, IS903, and ISCR1 was sought by PCR according to García-Fulgueiras et al. (13). In this regard, bla_{CTX-M-14} was found upstream from IS903, which is consistent with previous reports by other authors (5). We were unable to detect any association between IS26, IS{Ecp1}, or ISCR1 upstream from bla_{CTX-M-14}. Plasmid incompatibility group was determined by PCR according to Carattoli et al. (9).

Both β-lactamases were encoded in a ca. 95-kb IncI1 plasmid (data not shown). IncI plasmids are considered one of the five “epidemic resistance plasmids” due to their frequent association with ESBL genes (7). Nevertheless, only rare reports from Korea and the United Kingdom have described the association between IncI plasmids and CTX-M-14 (16, 27). As a rule, IncI plasmids
TABLE 1 Antibiotic susceptibility of S. enterica serotype Enteritidis SE1101 and transconjugant TcSE1101

<table>
<thead>
<tr>
<th>Antibiotic(s)</th>
<th>ST1101</th>
<th>TcSE1101</th>
<th>E. coli J53-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>≥32</td>
<td>≥32</td>
<td>4</td>
</tr>
<tr>
<td>Sulbactam-ampicillin</td>
<td>≥32</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>≥64</td>
<td>≥64</td>
<td>8</td>
</tr>
<tr>
<td>Ceftriaxime</td>
<td>≥64</td>
<td>8</td>
<td>≤1</td>
</tr>
<tr>
<td>Cefazidime</td>
<td>4</td>
<td>≤1</td>
<td>≤1</td>
</tr>
<tr>
<td>Cefepime</td>
<td>2</td>
<td>≤1</td>
<td>≤1</td>
</tr>
<tr>
<td>Meropenem</td>
<td>≤0.25</td>
<td>0.25</td>
<td>≤0.25</td>
</tr>
<tr>
<td>Amikacin</td>
<td>≤2</td>
<td>≤2</td>
<td>≤2</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>≤1</td>
<td>≤1</td>
<td>≤1</td>
</tr>
<tr>
<td>Nalidixic acid</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>≤0.25</td>
<td>(0.023)</td>
<td>≤0.25 (0.032)</td>
</tr>
<tr>
<td>Tazobactam-piperacillin</td>
<td>≤32</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>Sulbactam-ampicillin</td>
<td>≤32</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

*Values in parentheses were determined by Etest.

have been linked to the dissemination of CMY-2, CTX-M-1, and TEM-52 β-lactamases (7). Interestingly, IncI1 plasmids have been linked to food-borne diseases on account of the high prevalence of such plasmids in Salmonella isolates of avian origin (8).

The occurrence in Uruguay of ESBL-producing Salmonella isolates is an extremely rare event; in this sense, in the year 2006, we reported the presence of blaCTX-M-14 carried in a transferable plasmid in Salmonella enterica serotype Derby obtained from eggs (29), but the clinical relevance of such a finding is still unknown. Nevertheless, so far in our country, there have been no reports of ESBLs in Salmonella Enteritidis of human origin.

The fact that this enzyme is encoded in a plasmid that only carries resistance to β-lactam antibiotics could be explained by the recent emergence of this gene in the region and the lack of recombination events with other genetic structures, as was previously suggested for the multiresistance plasmid pTN48 (5).

The acquisition of antibiotic resistance genes by agents of gastroenteritis (which generally cause mild symptoms that do not require a medical consult) constitutes a sanitary alert due to the presence of such genes in the community setting (30). The fact that Salmonella Enteritidis occurs epidemically, associated with food-poisoning outbreaks, and that blaCTX-M-14 is carried in a conjugative plasmid increases the potential for dissemination of such genes.

The presence of an addiction system in plasmid pSE1101 could help with establishing blaCTX-M-14 within a given bacterial population as well as increasing the chances of its maintenance in the bacterial progeny. It is necessary to remain vigilant toward Salmonella antibiotic susceptibility levels in order to minimize the impact of possible outbreaks of this strain or the dissemination of its plasmid.

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REFERENCES


